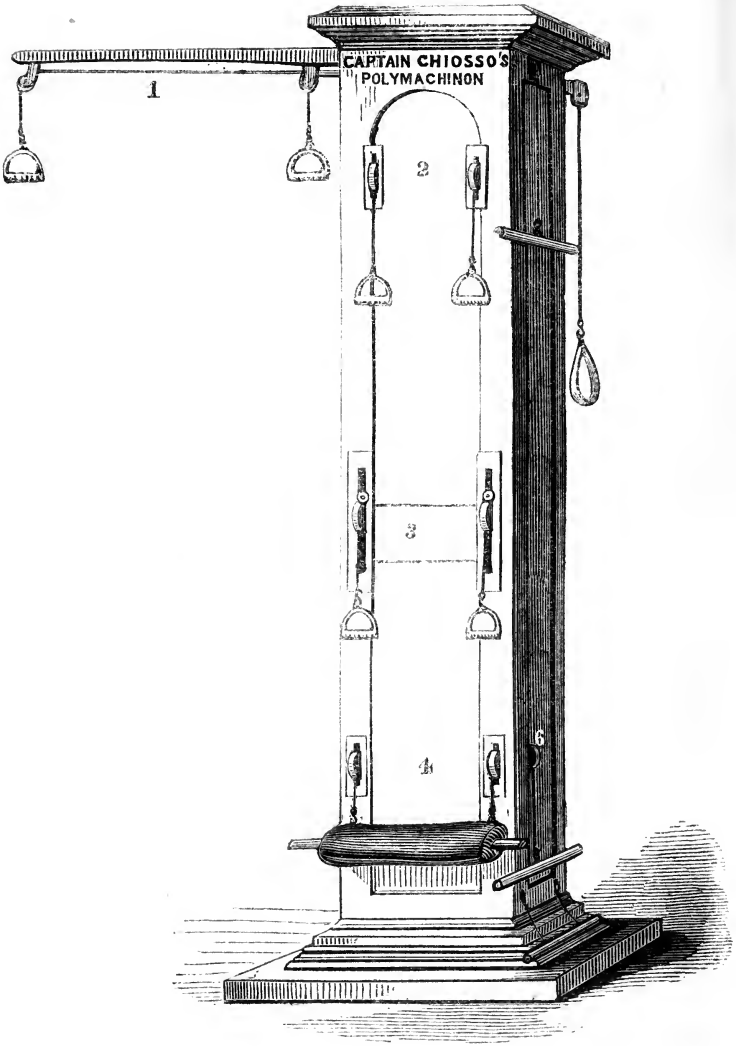
THE

GYMNASTIC POLYMACHINON.


CAPTAIN CHIOSSO'S
POLYMACHINON
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THE

GYMNASTIC POLYMACHINON.

INSTRUCTIONS FOR PERFORMING

A

SYSTEMATIC SERIES OF EXERCISES

ON THE

GYMNASTIC & CALISTHENIC POLYMACHINON.

BY CAPTAIN CHIOSSO,

THE INVENTOR, PROFESSOR OF GYMNASTICS AT UNIVERSITY COLLEGE SCHOOL, LONDON, AND AUTHOR OF SEVERAL TREATISES ON PHYSICAL EDUCATION.

"Ah! what avail the largest gifts of Heaven
When drooping health and spirits go amiss?
How tasteless then whatever can be given!
Health is the vital principle of bliss,
And exercise of health." THOMSON.

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1855.

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INTRODUCTION.

In a former Treatise* I considered Gymnastics as an essential branch of popular education, and an invaluable remedial agent in many forms of chronic disease; and the favourable reception of that work by the press and public, together with the daily extending interest manifested in this important subject, have induced the publication of this little manual.

For while the Author views with pleasure the advance of physical education, he is aware that many, who would willingly adopt exercise as a hygienic or curative medium, either have not access to gymnasiums, or are deterred through ignorance of the movements they should adopt, as well as from fear of the evils resulting from indiscriminate and violent exertion; and for such, the following series of scientifically arranged exercises will be found admirably suited, as the Polymachinon combines perfect safety, with all the essential elements of the most elaborate gymnasium.

HISTORY OF THE POLYMACHINON.

Bodily exercise, to be of use, not temporarily but permanently, must be of such a nature as to act gradually on the various complicated sets of motors of the body in every possible way, from the head to the feet, without the chance of their receiving the least strain; and the first efforts to produce an instrument, by which this might be securely effected, were made by the author in the year 1829.

These met with signal success, and were fully appreciated by all who placed themselves under his care; amongst whom might be mentioned many eminent members of the medical profession. Still, these attempts, though essentially good, lacked many

* Rationale of Gymnastics.

requisites for carrying out his views. Sensible that injury of a serious nature was likely to accrue to young persons, as well as adults, in attempting the performance of feats of strength on *immoveable* resisting substances, before the various muscles were rendered fit for such exertion, it was not until 1831 that an instrument was devised, which appeared to possess the desired virtues.

This consisted of a rough and strong frame-work of wood, of rather large dimensions; to which were attached blocks, through which cords passed to the different weights (required for the various movements), situated on a platform at the base of the machine; handles being attached to the other extremity of the cords, by which the weights were set in motion. Although possessing advantages, it was found, after some time, to be deficient in many respects. First, the weights being all exposed, and the danger likely to arise from children or young persons touching them while in motion. Again, the rough and clumsy appearance of the whole; the requiring a great number of weights, regulated to the powers of different individuals, and the very limited amount of exercise that could be performed, proved it far short of what was required. Perceiving these faults, the Inventor endeavoured to surmount at least some of the chief difficulties; and in the year 1836 another apparatus was conceived. It consisted of two simple upright planks of good strong deal, about thirteen inches wide and one inch and a-half thick, placed opposite to each other, with an intervening space of about seven feet and a-half; these were fixed firmly into the floor, and joined at the top by means of a transverse beam of the same width as the uprights. In this frame-work of wood pulleys were fixed at different correct points, to take the place of the blocks in the old instrument, through which the different cords passed to the weights; the arrangement of which, also, differed materially, To the two uprights were fixed two plates of wrought iron, each carrying two strong levers of the same material, about two feet and a-half in length, by three inches wide, each having two rows of holes running the whole length, one placed above the other; the lower being for the

adjustment of the weight, weighing about 4lb., of lead or iron, and the top for the fastening of the hook attached to the various cords, which, after passing through the different pulleys, terminated in handles. Thus, there was the great advantage of merely having four weights, which by this simple arrangement could be easily adapted to the powers of any individual, by moving them up or down the lever as the case required. For instance, in adapting it to the strength of a weakly person or child, the weight was approximated to the fulcrum (which of course was situated on the plates before described), and the hook removed towards the extremity of the lever; while for a stronger individual, the reverse took place. After many years of practice this arrangement was found incomplete, inasmuch as by it great danger was still apparent, in the mischief possible to arise to young persons from touching the levers and weights when in motion. Besides, the continual noise caused by the metals clashing, and the immobility and unprepossessing appearance of the whole. The two first difficulties were at last overcome.

The new design consisted of two square upright columns or boxes of wood, fourteen inches square and eight feet high, divided into a certain number of compartments, running from the top to the bottom; the columns were placed opposite each other, and fixed firmly, by means of screws, to the floor, being joined at the top by means of a stout plank of deal, as a means of transmitting the cords (through the medium of pulleys) from one box to the other: the compartments were for the weights to run up and down, so that one should be quite independent of the other, and remove all fear of clashing and getting entangled. Although this succeeded admirably, it still lacked essential qualities:—1. That of being portable. 2. Being of such size and bulk, that the space occupied should be inconsiderable. And 3rd, having such an arrangement of weights, that with ease they could be made lighter or heavier, as required. However, after much labour, the Inventor finally succeeded in producing a combination, so arranged as to meet, in the form of a single instrument, the great desiderata.

DESCRIPTION.

The "Gymnastic and Calisthenic Polymachinon" consists of a single column or box of wood, varying from one to two feet in diameter, resting on a broad and secure pedestal or base. Its height is about eight feet, having at the top a projecting arm, to which are attached pulleys and handles for particular exercises. The machine, according to size, is divided into a certain number of compartments, from twenty downwards, which admit weights of a certain construction to move up and down without the least friction, and obviates the possibility of jostling. At the top is a complicated arrangement of pulleys (supplied with leaders to prevent the cords escaping from the grooves), so placed as not to interfere in the least one with the other; there are also pulleys on the exterior of the apparatus, over and under which run gutta percha cords (with handles fixed at their outer extremity) passing to the interior, and attached to the weights in the base. Rollers of hard wood, working in brass sockets, are placed by the side of certain pulleys, that the cord may be pulled laterally without slipping off, thus giving an almost unrestricted sphere of movement. It being necessary to increase or diminish the amount of individual weights according to necessity, doors are placed at the base of the machine that they may be easily altered, or any disarrangement rectified; at the top of the apparatus a moveable cap, fitting closely over the pulleys, prevents the accumulation of dust, and is easily removed when these require oiling, or replacing, &c. The doors being shut and the lid adjusted all the weights are hid from view, and thus no accident can possibly take place.

The weights used in these machines being rather peculiar in construction, a short description may be interesting. It being necessary that the various weights be easily *augmented* or *reduced*, a method was devised which perfectly answers the end. This consists of a rod of iron (two feet in length), having as a base a piece of round lead or iron, about two inches and a-half in diameter, with a sliding cap which moves up and down the

rod, and made to fit accurately on the weight below. By means of a hollow surface, which rests on a corresponding elevation, intermediate weights are then placed between the *two*, by means of a slit in each extending to the centre, and having a projecting surface on one side and a depression on the opposite, so as to fit its fellows above and underneath, thus preventing the possibility of any one slipping off during exercise; and at the same time allowing easy removal, or prompt adjustment. Pads of wool placed at the bottom of each compartment prevent all noise. On the exterior of the apparatus numbers are affixed to the different handles, that the various movements may be easily arrived at and remembered.

The prominent advantages of this instrument, for domestic use, may be stated as:—

1. Being small in bulk, the space required for it, when in use, is of so little import that it may with ease be employed in an ordinary room.

2. Being placed on rollers, it can, when done with, be located in a recess, and withdrawn at pleasure, thus doing away with the inconvenience arising from fixed apparatus.

3. That it may be used by one person at a time, or by a number of persons not exceeding ten, acting totally independently of one another.

4. That the different appliances, such as weights, handles, &c. are so arranged, that without the slightest trouble they can be adapted to the strength of any individual.

5. That it may be used by children in the nursery or playroom, without the least fear of accident.*

6. That let as many individuals as stated be at work at the same time, there is no annoyance produced through noise.

7. That to families in town or country it will afford to the younger branches that fund of *amusement*, embodied in the shape of useful *occupation*, when inclemency of weather, or other circumstances, prevent out-door exercise.

8. It can be packed and sent off with facility, and small

* As a rule, however, it is always *better* that some competent person should superintend the use of the machine.

expense, which, to persons leaving town or changing residence, are points of importance.

9. The elegant and ornamental structure of the whole fits it for a prominent position in the dining-room, library, or boudoir.

RULES TO BE OBSERVED DURING EXERCISE AT THE POLYMACHINON.

1. The correct *position* of the *body* during the various exercises at the Polymachinon is so thoroughly essential, that it must be observed and adhered to with the utmost strictness, as by any deviation from it the object of the movements will be frustrated.

2. That all exercises are to be performed gently, no violence taking place, so that the part of the body in motion may receive no sudden jerk or shock, which may be productive of a strain.

3. That it is perfectly necessary, between the finishing of one exercise and the commencement of another, that an interval of at least three minutes elapse, so that the muscles thus rested may gain strength through the blood having time to form the deposit requisite to the formation of muscular fibre.

4. That movements of opposite tendencies must be taken alternately, so that one set of muscles may not always undergo the same exertion, whilst others are dormant: thus after using the arm in a motion which calls into action its *flexor* muscles, it must next have the antagonist or *extensor* muscles brought into play by an opposite movement, and so with every part of the body, else an unequal development takes place.

5. That the time for exercise must be well studied. It is equally injurious to the whole body to take exercise immediately *before* a meal or immediately *after*, as the organs of digestion then lack the stimulus requisite for a healthful production of the various secretions. The best time, therefore, to exercise at the Polymachinon, is about one hour before or two hours after a repast.

6. That the body during exercise must be perfectly unrestrained; braces, belts, or tight garments of any description are *evils* to be at once thrown aside.

7. That at the termination of every exercise the weights are to be let down gradually and gently; as by allowing them suddenly to drop a shock is given to the limb, and the machine may possibly be damaged.

8. That exercise must never be continued until a sensation of fatigue overcomes any part of the body, exhaustion being hurtful in the extreme; for instead of an increase taking place, the parts thus acted upon actually waste.

9. That it is desirable, as strength increases, to augment the number of times the limbs or other parts of the body move, in preference to increasing the amount of weight; thus, if after a fortnight it is found easier than at first to move a weight of say ten pounds, for twenty times to and fro, perform the movement thirty times, and so on until a further advance is necessary.

The individual about to commence exercises at the Polymachinon, having made himself perfectly acquainted with these rules, will proceed with the performance of the various movements (exercises) in the order laid down in the succeeding pages. But it must be understood, that system and regularity are most essential. Thus, if in one day we have ten movements, the next day the ten following in order may be performed, or a repetition of the first, if necessary. It would be almost impossible, certainly hurtful, to perform all, consecutively, during one lesson. The arrangement, however, must be determined by the gymnast, or by the party himself.

The following may be specified as some of the maladies in which the use of the Polymachinon will be most beneficial :—

Congestions of the Head, Giddiness, &c.
Hypochondriasm.
Narrow and contracted Chest.
Asthma.
Constipation.
Obesity.
Affections of the Heart.

Derangement of the Digestive Organs.
Nervous Affections.
Epilepsy.
Paralysis.
Curvatures of the Spine, and other Deformities.

JAMES CHIOSSO.

LONDON GYMNASIUM,

123, OXFORD STREET, near Regent Circus;

21, NEW ROAD, corner of Gower Street North;

Or at Captain CHIOSSO'S PRIVATE ESTABLISHMENT for the Cure of Chronic Diseases and Spinal Complaints, 38, BAKER STREET, Portman Square.

SYSTEM OF EXERCISES

OF THE

GYMNASTIC POLYMACHINON.

MOVEMENTS OF THE HEAD.*

1. Upward and Backward Traction. (*Figure* 1.)

Position.—The pupil, being seated facing the front of the machine, will have the padded head-piece applied and secured to the head by means of well regulated straps, so as to prevent its slipping off, or altering position; the gutta-percha cord, which is attached to the cap in front by means of a swivel, is continued through the proper pulley, placed according to the position of the pupil or patient, either in the centre, midway between the centre and base, or at the base of the apparatus.

Exercise.—The above rules for the position having been observed, the head, which is now held down by the weight, is to be brought upwards and gradually forced backwards, as far as possible, without altering the position of the body, being careful not to allow the trunk to enter into the movement with the head in the least degree throughout

* The exercises and movements of the *head* (neck) have been inserted here only for the sake of *completeness*. The Polymachinon being, in the main, a hygieistic and educational contrivance, ought never to be used in real maladies or deformities, but by the advice and under the control of a professional Gymnast or Kinesitherapist. The *head*, especially, being a compound of organs so very important and delicate, ought never to be acted upon but with the greatest caution; besides, the *consensus* of muscular power mentioned in our *Rationale of Gymnastics* (page 31), will prove to every one, that in most cases, while the generality of muscles are strengthened and improved, those of the neck will partake of the same advantages.

the exercise. The first position is now to be assumed by allowing the head to return forward and downward, repeating the movement until the required number has been performed.

Muscles.—The chief muscles which enter into the performance of this movement, are such as are destined to keep the head well up and erect on the trunk (*rectus posticus major et minor, complexus, splenius capitis,* &c.); and thus, through their proper exercise and development, will obviate that unsightly habit of dropping the head forward (brought on through weakness of those parts) observed so frequently amongst the youth of both sexes.

2. Forward and Downward Traction. (*Figure* 2.)

Position.—The position of the pupil or patient is to be the same as in the preceding exercise, with the exception that the back instead of the front will be turned towards the machine.

Exercise.—This is the opposite of the preceding, the head being brought forward and downward, instead of upward and backward: the movement is to be continued until the number of times prescribed is completed, observing strictly, that the body is to remain steadily fixed, and not to enter into the movement.

Muscles.—From the fact of this exercise being the reverse of the last, of course the *antagonist* muscles, to those before acted upon, will be exerted (the chief of which will be the *longus colli, sterno-mastoid,* &c.); and thus care must be observed in the performance of this movement, else the development of those muscles will be too great.

3. Lateral Traction or Flexion. (*Figure* 3.)

Position.—The pupil being placed in the sitting position, sideways towards the apparatus, at a correct distance from

Figure 1.
Upward and Backward Traction.

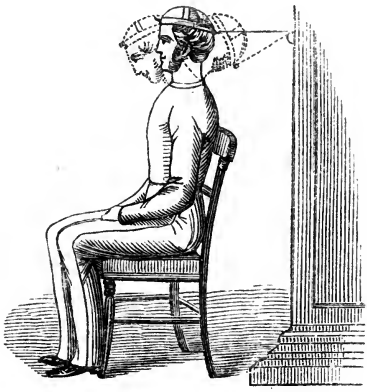


Figure 2.
Forward and Downward Traction.

the machine, has the head-piece affixed with due care and exactitude.

Exercise.—The head in this movement is either flexed from right to left, or left to right, according to the position of the body; if that of the right side be next the machine, the former will be the case; if the left, the latter will be the exercise; this, of course, must be regulated according to the weakness or disease of the pupil or patient. It may be well to observe here, that the eyes are always to be directed forwards, never letting the head drop.

As a general rule, where the object of the pupil is merely the acquirement of strength, then, when one side has been exercised, the position of the body is to be reversed, and a similar number of movements performed on the opposite one.

Muscles.—The chief muscles brought into action are the *recti-laterales, inter-transversales,* &c., in combination with those which separately move the head forward and backwards, giving them increased power in maintaining it in an erect position.

4. Horizontal Rotation. (*Figure* 4.)

Position.—The position of the pupil is the same as that described in the last exercise.

Exercise.—The head is to move from the above position, in a horizontal direction, until the chin is quite over one shoulder (say the right), without the trunk being moved in the least; it is now to perform a similar movement in returning, until passed over the opposite shoulder; the exercise will be completed when, by repeating the movement from side to side, the required number of times has been performed.

Muscles.—The *trapezius* takes a strong part in this movement in unison with the *splenius capitis, splenius colli,* and *sterno-mastoideus,* &c. acting as rotators; the command of

Figure 3.
Lateral Traction or Flexion.

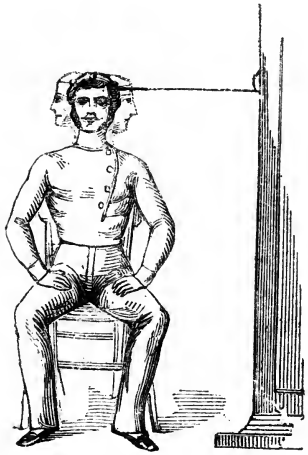


Figure 4.
Horizontal Rotation.

which, through a general development, gives freedom in moving the head as may be required, either in walking, or in different movements of the body.

5. Upward and Backward Traction, with Lateral Flexion in Rotation. (*Figure* 5.)

Position.—The pupil is to be placed precisely as in the last exercise.

Exercise.—This is a combination of the first exercise (upward and backward traction), with the third (lateral traction or flexion). The first action is that of the head being drawn laterally upwards, and so continued backwards, allowing it to drop on the opposite shoulder as it approaches the termination of the movement; this is to be continued for a certain number of times, when the inverse is to take place by reversing the movement, care being taken not to move the body in the least, throughout the exercise.

Muscles.—The combined muscles, which move the head backwards (part of *trapezius, rectus posticus, major et minor, obliquus superior*), with those that move it laterally (*sterno-mastoideus,* &c.), are by this exercise brought into action.

6. Forward and Downward Traction, with Lateral Flexion in Rotation. (*Figure* 6.)

Position.—The pupil is to be placed as in the third exercise.

Exercise.—In this, the second exercise and the third are combined in one continuous movement, as in the preceding. The head in the first place is brought laterally forward and continued downward, ascending on the opposite side until again leaned quite backward; this is to be continued, until the number of times required be completed, when

Figure 5.

Upward and Backward Traction, with Lateral Flexion in Rotation.

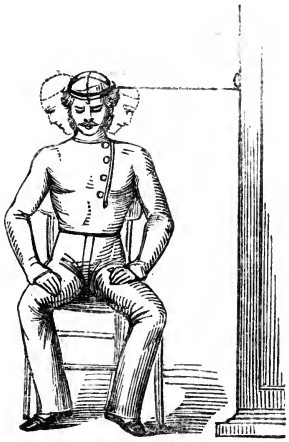


Figure 6.

Forward and Downward Traction, with Lateral Flexion in Rotation.

the movement is to be reversed, until the exercise is finished.

Muscles.—Those which present a somewhat *antagonistic* force to the preceding, are duly brought fully into action, as the *rectus anticus major et minor,* &c.; and aid with the rest of the muscles of the neck, through their consequent development in giving a proper position to, and in rendering perfect the various movements of, the head and neck.

MOVEMENTS OF TRUNK ONLY.

1. Forward Flexion. *(Figure 7.)*

Position.—The pupil is to be placed with the back to the front of the apparatus, either standing, sitting, or lying down. The pad placed at the base of the apparatus is then to be adjusted on the chest, and the weight decreased or increased according to the powers of the pupil. The hands to hold those of the assistant, or to rest on the handles of the pad.

Exercise.—The trunk is now to be brought forward gradually until the chest approaches the advanced leg, as near as possible; it is, from this position, gently to ascend and extend on the loins, stretching as far back as possible without losing the balance, when the movement is to be repeated; so that after the number of times are performed, the exercise will be completed. The legs will be alternately flexed and extended, as the trunk is either brought forward or backwards.

Muscles.—Those muscles which are inserted in the *pelvis* and originate in the *thorax,* that is to say, the ribs, &c., as

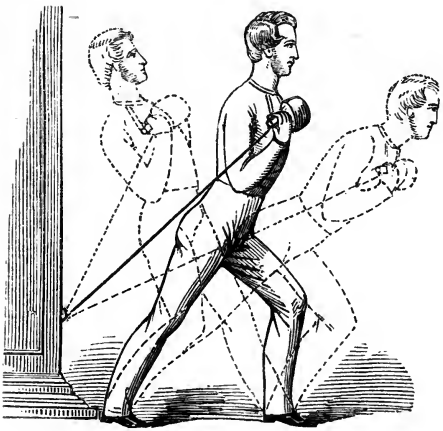


Figure 7.
Forward Flexion.

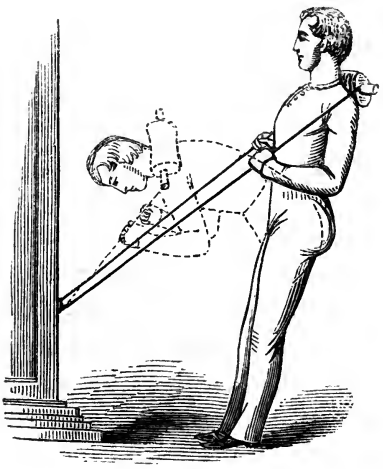


Figure 8.
Upward Traction.

the *rectus abdominalis*, &c., are in this exercise most perfectly exercised, and consequently developed, while at the same time the organs of digestion, &c., are healthfully stimulated.

2. Upward Traction. (*Figure* 8.)

Position.—The pupil, standing erect in front of the machine, with the heels close together, will place the pad for that purpose on the shoulders, by a smart movement upwards of the arms; the hands are then to rest on the cords, to steady and prevent the pad from slipping off.

Exercise.—From this position the body is to be inclined well forward, without the legs being bent in the least; having reached as low as possible, it is now again to be forced gradually upwards (allowing the movement to take place solely at the loins), until the erect position is attained. A repetition of these movements, for the required number of times, will complete the exercise.

Muscles.—The object in this exercise is to develop and strengthen the muscles of the loins, back, and neck, a combined action of which takes place throughout the movement. The chief sets that are acted upon, are the *trapezius, latissimus dorsi, multifidus spinæ, longissimus dorsi, quadratus lumborum*, &c.

3. Erect Rotation. (*Figure* 9.)

Position.—The position of the pupil differs from that observed in the preceding exercise, one side of the body being presented to the machine (say the right), instead of the front. The legs are to be separated, with the feet firmly planted on the floor or ground; the strap placed in the middle pulleys of the machine is now to be adjusted, so that the cord runs direct from the shoulder.

Exercise.—The position of the legs being strictly main-

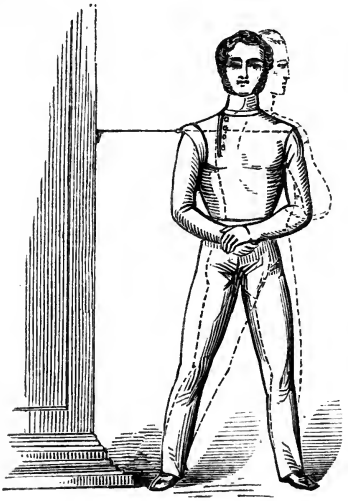


Figure 9.
Erect Rotation.

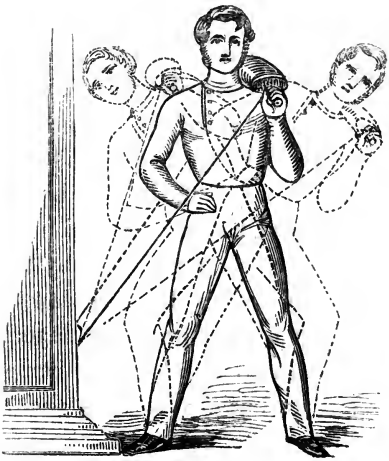


Figure 10.
Lateral Traction.

tained, the shoulder to which the cord is attached is to be brought round as far as possible, until it is at a right angle with the legs (that is to say, in the same plane); from this point it is again to turn back, not stopping at the point of starting, but passing as far behind as possible. This to and fro movement must be continued gently and unceasingly, until the number of times prescribed have expired. The other side of the body must then be exercised in like manner.

Muscles.—All those sets of muscles destined to turn the upper part of the body on the loins, are thoroughly exerted, and by a continuance of this exercise acquire great power.

4. Lateral Traction. *(Figure* 10.)

Position.—The padded handle at the base of the machine is to be grasped with both hands, drawn out and upwards, and placed on that shoulder of the pupil which is most distant from the machine (either by the assistant, or by the pupil himself), it being in this instance the left,—the right consequently being nearest the apparatus. To give power in the movements, the legs must be separated, firmly fixing the feet on the floor at a distance between them regulated to the stature of the pupil; the nearest foot to the base of the apparatus must be distant from it about the length of two feet, the trunk being kept quite erect, with the left hand holding the pad, whilst the right is placed on the hip, or hanging down by the side.

Exercise.—Observing the rules laid down for the position, the trunk must now be gradually flexed over to one side (in this instance the right, that side being nearest the machine), allowing the weight to drag the body in that direction as low as possible, flexing at the same time the corresponding leg in a slight degree; with a gradual effort the body is now to be brought up into the erect position,

and then bent slowly over to the opposite side, pulling, of course, the weight after it as far as possible. The exercise, to be completed, requires a continuation of these movements from side to side, for the given number of times. The opposite side of the body is then to be turned to the machine, and the pad adjusted as before described, when a similar number of movements are to be performed.

Muscles.—Those muscles which are most strongly acted upon in this exercise, are such as have a direct tendency (in combination with others) in flexing the trunk laterally, as the *obliquus externus et internus*, *quadratus lumborum*, *longissimus dorsi*, *sacro-lumbalis*, &c., the development of which is most essential in aiding the *dorsal* muscles to a complete and just performance of all movements of the body, whether in walking, jumping, running, &c.

5. General Rotation. (*Figure* 11.)

Position.—The rules laid down for the position in the second exercise (page 26, Fig. 8), are also in this to be strictly observed.

Exercise.—This is a combination of the three preceding exercises performed in one continuous movement. First, the body is allowed to turn round on the hips as in the third exercise; from this position it is to be bent over to the side as in the fourth, performing a rotatory movement at the loins, so as to be well flexed in ascending on the opposite side, to assume the first position, as in the second exercise. After the movement has been repeated some times, the inverse must then take place, until the exercise is completed.

Muscles.—As this is a combination of the three before-described movements, consequently their combined series of muscles are brought into play, as the *lateral* muscles of the abdomen, the *rotators* and the *erectors* of the trunk. These

acquire great strength, and, through the development of their several fibres, give a firmness to the whole body, and rectify any weakness or pains in the back, arising from debility, especially in the growing subject.

MOVEMENTS OF THE ARMS.

1. Erect Flexion. (*Figure* 12.)

Position.—The pupil is to be placed perfectly erect, under the projecting arm of the machine, accurately between the two handles appended thereto; the knees are to be quite extended, though by no means stiff; the heels close together, with the toes apart; the hands to be placed over the head and the handles taken hold of, one in each hand,* leaving the arms quite extended and holding the handles lightly with the first phalanx of the fingers.

Exercise.—Commence by drawing one arm (say the right) down, until the thumb of that hand touches the projecting part of the chest on that side, the elbow being close to the body, not allowing it to protrude behind; from this position allow the hand to ascend at the same time as the other descends, finishing in the same position as the latter, and so continue the movement until the exercise is completed; when finished, then both arms are to move together, arriving at a level on each side of the chest.

Muscles.—The chief muscles called into play in this exercise are, first, the *flexors* of the fore-arm on the arm, viz., the *biceps* and *brachialis anticus;* the *pectoral* muscles are also exerted, in unison with the *trapezius* and *latissimus dorsi,* in drawing the arm downwards.

* If the handles are too far out of reach, to avoid any possibility of straining in an effort made to get them, a hook is provided for the purpose of pulling them down.

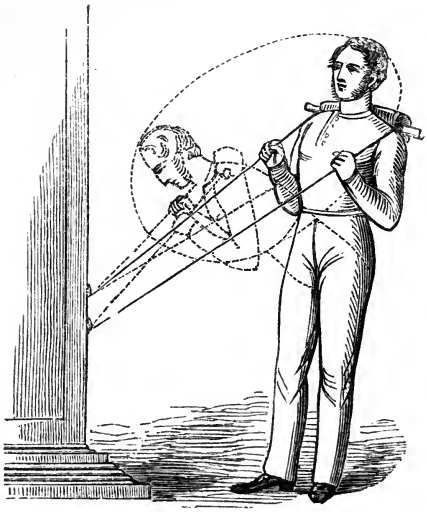


Figure 11. General Rotation.

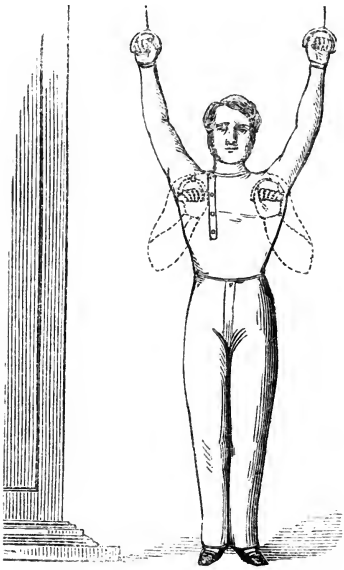


Figure 12. Erect Flexion.

2. Inclined Forward Extension. (*Figure* 13.)

Position.—In this exercise the pupil, placed to the front of the machine with the back turned towards it, is to pass the hands behind and take hold of the two handles situate directly at the back, on a level with the elbows, and bring them to the front of the body from under the arms, the cords remaining in that position. The handles, when in front, are to rest in the hollow between the thumb and first finger, and there retained throughout the exercise; from this position take a step forward with one foot (say the right), about the distance of two feet from the other, assuming rather the attitude of the statues of the ancient athletes, the toe of the advanced foot being turned a degree outwards; the advanced leg to be kept bent with the knee over the foot, whilst the other is to be perfectly extended.

Exercise.—Let the right arm be gradually and thoroughly extended in front of the body, the hand being at the height of the head, and the shoulder reaching well forward; from this position the hand is to return to its former one, through the bending of the arm, while the left arm gradually extends and assumes that of the former, continuing so for a given number of times; when completed in that attitude, reverse the position of the feet and perform a similar movement for as many times as prescribed, when both arms are to be used at once in projecting the handles, either with the feet changed or not.

Muscles.—The chief muscles which are called into action in this exercise, are the *extensors* of the arm *(triceps)*, which stretch them forward, the trunk being moved and kept forward by the *pectoral* muscles and the *seratus magnus*, with those of the abdomen, viz., the *rectus abdominis*, *obliquus externus abdominis*, and *internus;* as also, slightly, the *psoas* muscles. As there is always a slight flexion and extension of the lower limbs, of course the respective muscles are also brought into action.

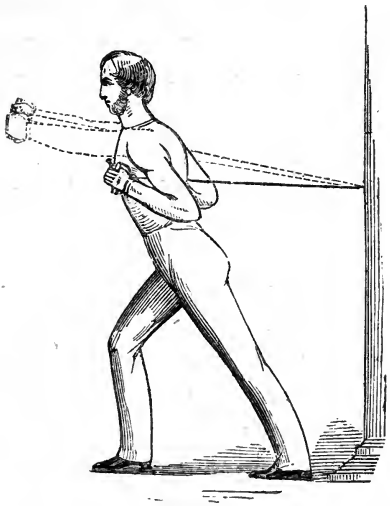


Figure 13. Inclined Forward Extension.

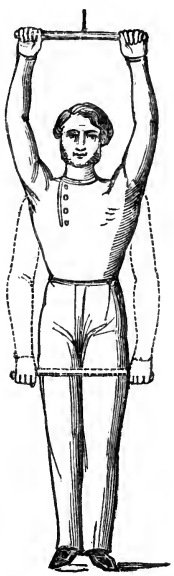


Figure 14. Erect Rotatory Adduction.

3. Erect Rotatory Adduction. (*Figure* 14.)

Position.—In this exercise the pupil is to be placed with the back towards and leaning against the machine, the head and back resting in contact with it, the legs quite straight, heels close together and placed about four inches from the base of the Polymachinon; both arms being placed over the head, and taking hold of the handle at each extremity with the full grasp.

Exercise.—From this position commence by bringing both arms downwards at full length (that is to say, without bending them in the least), very slowly, gradually and without the slightest jerk, until the hands have reached their lowest point in front of the body; they are now to ascend by bending the arms and drawing the handle towards the body, (performing a rotary movement at the shoulder joint with the arm, similar to that produced when turning a windlass,) letting it ascend until they reach the point of starting, above the head; the exercise is to be continued until the number of times prescribed is completed. Particular care must be taken that the body does not move from the machine throughout the exercise.

Muscles.—The muscles chiefly acted upon in this exercise, are those of the chest *(adductors)*, the *extensors* of the arms, as well as the muscles of the fore-arm, in maintaining the hold; also, some of the *dorsal* muscles, and those of the neck.

4. Lateral Extension. *(Figure* 15.)

Position.—The pupil, in this exercise, is not to face the machine, but to stand sideways to it, presenting one shoulder (say the right) to one of the middle handles, the shoulders being kept quite square, and retained so throughout, the feet separated about a foot and a half, and planted

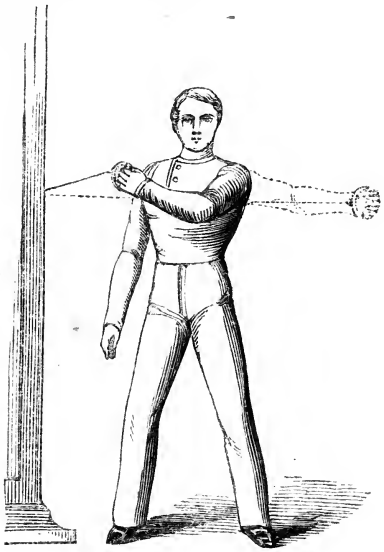


Figure 15. Lateral Extension.

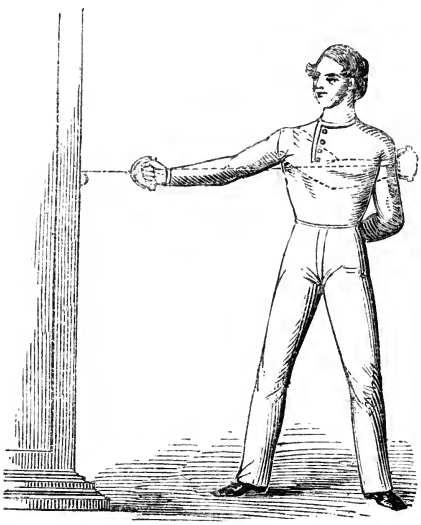


Figure 16. Lateral Flexion and Extension.

firmly on the floor, the nearest to the apparatus being placed the full length of the arm, and rather more, from the base of it; the knees are to be straight, and kept so during the exercise, but on no account stiff. The hand which is most distant from the handle (which will in this instance be the left) is then passed across the chest, and taking hold of it with the fingers, will, by flexing the arm, draw it into position before the right shoulder.

Exercise.—The arm is now to be extended very slowly, gradually and laterally from the chest, until perfectly straight, on the opposite side of the body (the left), and in a line with both shoulders; the handle is held in the beginning by the fingers only, but so soon as the lateral extension commences, is dropped into the hollow formed by the thumb and first finger, thus giving more power to the member to complete the movement. The exercise is then completed by the arm returning to the first position, and continuing the movement until the number of times have expired. After an interval the position of the body is reversed, and the other arm is to be then exercised in like manner.

Muscles.—The muscles chiefly acted on in this exercise are those which straighten the arm (the *extensors*), the *deltoid* muscle, and also the muscles of the chest and back, especially such as are attached to the shoulder blade *(scapula)*, thus strengthening and developing those regions.

5. Lateral Flexion and Extension. (*Figure* 16.)

Position.—The position of the pupil in this exercise is precisely the same as that in the preceding, with the exception of the distance from the machine being augmented to about the space of twelve inches.

Exercise.—With the hand nearest the machine (say the

right) the pupil is to take hold of the handle with the fingers (not grasping it), by extending the arm. The handle is now to be *drawn* up to the centre of the chest, and then by dropping it between the first finger and thumb is *pushed* across to the other shoulder; the arm being extended as much as the position of the body will allow of, continue the exercise by allowing the arm to return to its former situation, repeating the movement forward and backward until completed.

Muscles.—The muscles chiefly acted upon are principally those of the chest, arms, back and shoulders.

6. Adduction, with Permanent Extension. (See *Figure* 16.)

Position.—The pupil is again to be placed as in the last exercise.

Exercise.—One of the middle handles being held firmly, (say with the right hand, it being in this instance the nearest to the machine,) is to be brought across the body at the full length of the arm, never allowing it to bend at all; the shoulder joint being the centre from which the arm moves, and the hand, of course, in its movement will describe part of the circumference of a circle, in its progress forward, or from the machine. It must be observed, that in this exercise the body is to be kept perfectly still, the only part moveable being the arm at the shoulder. The arm or hand, when it has arrived at the farthest point, is again to return towards the machine, resisting in its transit the weight, so as to allow of no jerk being given to the limb. When the required number of movements have been performed with the right arm, then the left is to be used in like manner.

Muscles.—All those muscles whose office is to draw the arm towards the body (*adductors*), are brought gently and

effectually into action. The muscles of the chest (*thorax*, the *pectoral* muscles) being the chief actors in this instance, as also the *biceps;* the body (shoulder) being the fixed point. The general muscles of the arm in keeping it straight, and those of the fore-arm in maintaining the grasp, are also beneficially exerted.

7. Abduction, with Permanent Extension. *(Figure* 17.*)*

Position.—The position of the pupil is the same as that of the last exercise, only placed a little closer to the machine.

Exercise.—This is the reverse of the one just described. The left hand in this exercise is passed across the body, and to take a firm grasp of the handle, the arm being kept perfectly straight. The action of this exercise is then, not as in the preceding, from the *machine* and *towards* the body, but *from* the *machine* and *from* the body. The arm throughout is to be kept perfectly extended, and when arrived at its farthest point, at the side of the body, the hand is to be on a level with the shoulder; from this point the movement is to be the reverse of the last, being drawn back into the first position by the weight, but resisting it to avoid the possibility of any jerk being communicated to the limb. The movement to and fro to be continued for the prescribed number of times, when the other arm is to be exercised in like manner.

Muscles.—From the nature of the exercise, and comparing it with the last, it is obvious, that just the opposite set of muscles are exerted, viz., the *abductors* of the arm, those which have a tendency, either separately or jointly, in moving the limb from the body, which would be those of the back and shoulder inserted in the arm, *latissimus dorsi*, &c. The fore-arm is extended on the arm and retained in that position by the *extensor* muscles; and the muscles of the fore-arm, used in maintaining the grasp, are also acted upon.

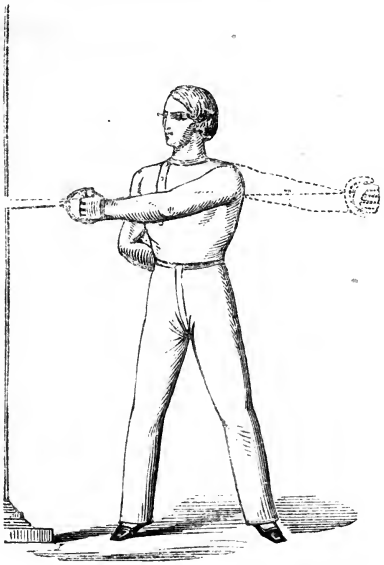


Figure 17. Abduction, with Permanent Extension.

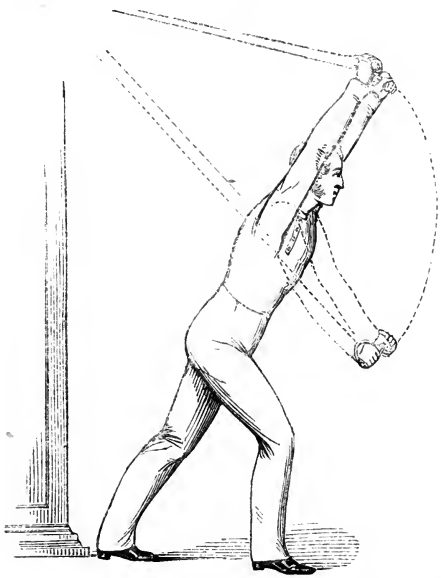


Figure 18.
Inclined Downward Traction, with Permanent Extension.

8. Inclined Downward Traction, with Permanent Extension.

(*Figure* 18.)

Position.—The pupil is placed in front of the machine, with the back turned towards it; the legs placed apart, the hindermost foot (say left) being fixed close to the bottom of the machine, and the foremost (right) about two feet from it, the heel being opposite the instep of the hind foot; the knee of the right leg to be bent, while that of the left is to be perfectly extended. The body to be leaned forward over the advanced leg. Before assuming this position, the two highest handles are to be taken hold of with the tips of the fingers, with the hands across one another, that is to say, the right hand will take hold of the left handle and the left the right, so that by drawing them out and giving a smart turn of the body, passing them over the head, the arms will be found in position behind the body, and quite extended.

Exercise.—In commencing the exercise, one arm is to be brought down, without bending it in the least, until in front of the body, as low as possible; as this arm ascends, the other is to perform the same movement and descend, until it has arrived at its farthest point; minding always, that neither bend in the slightest degree, so that when one is over the head, the other will be in front of the body; when this has been repeated the required number of times, then both arms are to be brought down together, and likewise to ascend; the feet are then to be reversed at the termination of the first part of the exercise, and a similar series of movements performed.

Another form of this exercise is that of allowing the arms to go backwards at full length from the first position, describing in their movement the circumference of a circle; the opposite to this movement may also take place, that is to say, instead of the arms going to the back of the trunk

at the commencement, they are first to come to the front and so continue downwards, as in the eighth exercise, completing the circle as they pass upwards behind the back; the arms in either exercise may be kept extended, or flexed at pleasure. (See *Fig.* 19.)

Muscles.—The muscles of the arms, chest, neck and back, are all acted upon in this exercise, which is extremely beneficial to the state of contraction of the chest, so prevalent in the greater portion of the youths of both sexes.

9. Upward Traction, with Arms passed behind. (*Figure* 20.)

Position.—The pupil, with the heels close together, toes apart and knees straight, is to stand erect, with the back towards the machine, the head being kept well up; the arms are now passed behind the lower part of the trunk, and by bending the knees the handle (placed at the bottom of the apparatus for that purpose) is to be taken hold of at the extremities with both hands, drawing it a degree upwards as the knees are again straightened; the trunk must now be in line with the legs, and inclined slightly forward, with a projection of the chest, taking care to throw the shoulders well back.

Exercise.—The handle, which is now held simply by the fingers of both hands (not being grasped in the least), is to be drawn upwards as high as possible, until the hands touch the lower angle of the shoulder blades; the handle from this position is now again to descend, as the arms are gradually extended, until it reaches the lowest point behind the body, as in the commencement of the exercise. By a repetition of this movement for the given number of times the exercise will be completed.

Muscles.—The chief muscles which are thus brought into action are the *flexors* of the arm, in combination with

those whose office it is to move the shoulder blades (*scapulæ*) upwards, as the *trapezius*, *levator scapulæ*, &c.

10. Lateral Downward Traction, with Permanent Extension.
(*Figure* 21.)

Position.—The pupil is to stand to the front of the machine, merely presenting one side, the feet apart, firmly fixed on the floor, and the knees flexible. One of the top handles is then to be taken hold of with one hand, say the right, that side being the one nearest the machine, the arm being kept perfectly straight.

Exercise.—From the above position, the arm is to be brought downward, perfectly extended, until it rests on the side of the body; it is again to rise and so repeat the movement for the number of times required; when the other arm is to go through the same movement.

Muscles.—This exercise is intended to have the effect of strengthening the *extensors* of the arm, and those muscles whose office it is to draw the arm to the body (the *adductors*). Some fibres of the *pectoral* muscles, as also the *trapezius*, are duly exerted, whilst of course the chest is beneficially acted upon.

11. Downward Lateral Rotation, with Permanent Extension.
(*Figure* 21.)

Position.—The pupil must be placed precisely as in the last exercise.

Exercise.—The arm being of course extended, is then to perform exactly the same movement in the commencement as in the forgoing exercise, and then, instead of stopping at the side of the body, is to pass to the front of it and continue round, forming a circle, until again arrived at the first position, the arm throughout never flexing in the least.

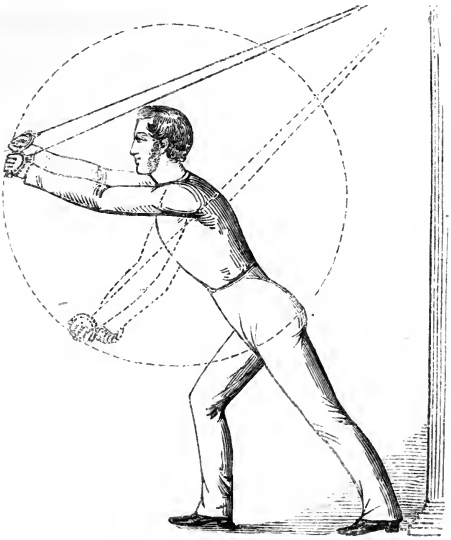


Figure 19.

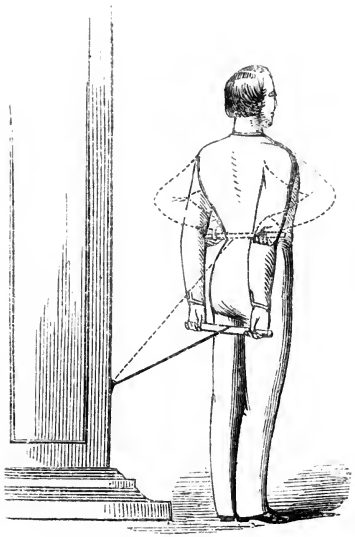


Figure 20.

Upward Traction, with Arms passed behind.

The other arm, by altering the position of the body, is then to be similarly exercised.

Muscles.—This exercise has for its object that of expanding the chest, and also strengthening it, at the same time as the shoulder joint is freely moved, and consequently all those muscles connected with it, in unison with those brought into action in the preceding exercise.

12. Upward Lateral Traction, with Permanent Extension.

(*Figure* 22.)

Position.—The pupil, being placed as in the two preceding exercises, is to take hold of one of the middle handles with the hand in the supine condition, the arm being kept quite extended.

Exercise.—The arm, say the right, is now to be brought quite over the head, without moving the body in the least, and then again gradually to fall into the first position. This up and down movement to be repeated for a certain number of times, when the opposite limb is to be used in like manner.

Muscles.—Again some of the muscles of the chest, and such as are destined to raise the arm (*deltoid*), are, through the practice of this exercise, much strengthened.

13. Upward Lateral Rotation, with Permanent Extension.

(*Figure* 22.)

Position.—The pupil to be placed as in the preceding exercise.

Exercise.—The same movement is to be performed in the commencement as in the last, but instead of stopping over the head, the hand is to be continued onwards until, in describing a circle, the point of starting has again been attained. This, like all the other movements, must be

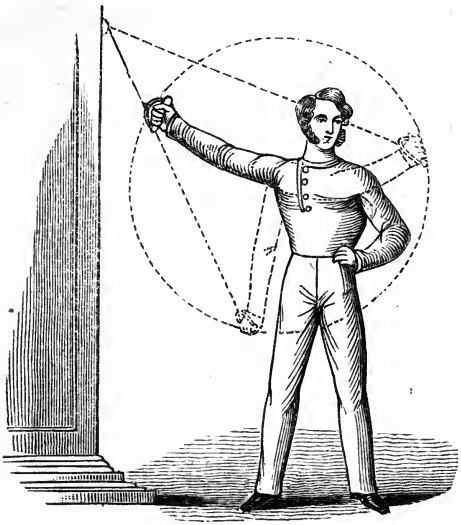


Figure 21.
Lateral Downward Traction, with Permanent Extension.

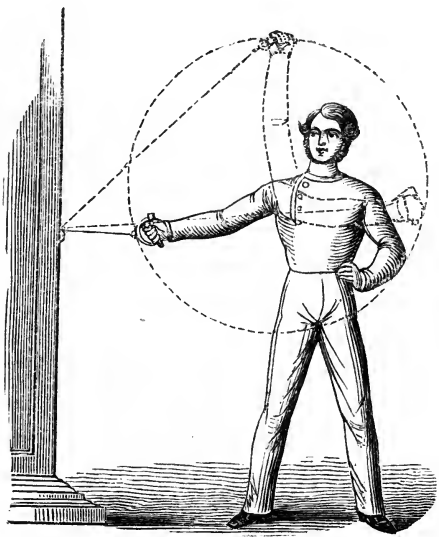


Figure 22.
Upward Lateral Traction, with Permanent Extension.

continued for a certain number of times, when the other arm is to be used in the same way.

Muscles.—The muscles brought into play in the preceding are duly exerted more completely, as are also the *pectoral* muscles.

14. Downward Forward Traction, with Permanent Extension.

(*Figure* 23.)

Position.—The pupil is to be placed facing the front of the Polymachinon. One or both of the top handles must then be taken hold of, the arms being kept perfectly straight; the feet, separated, are to be fixed firmly on the floor.

Exercise.—One hand is now to be brought down, and passed as far behind as possible, with the arm perfectly extended; this is again to ascend, whilst the other is brought down, and so the exercise is to continue for a given number of times, when both arms are to be used together.

Muscles.—All those muscles that are attached to the arm, and have a tendency to draw it nearer to the body (*adductors*), are brought into play. The *biceps* forms in this instance one of them, and of course the *trapezius*, &c., is fully exerted.

15. Direct Forward Traction, with Permanent Extension.

(*Figure* 24.)

Position.—The pupil, placed with the back to the front of the machine, with the feet apart, one placed before the other, firmly planted on the ground, will pass the hands behind, and take hold of the two middle handles, leaving both arms quite extended.

Exercise.—One arm is now to be brought directly forward, until it has reached the height of the shoulder in front of the body; this is to descend, and assume the first

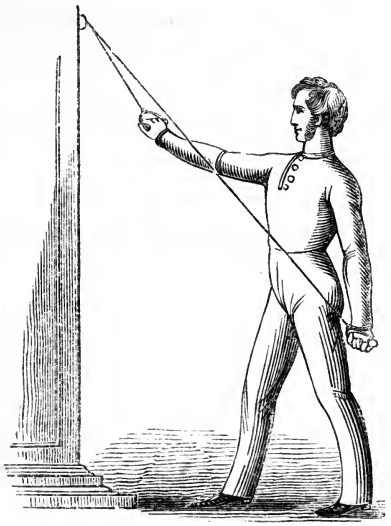


Figure 23.
Downward Forward Traction, with Permanent Extension.

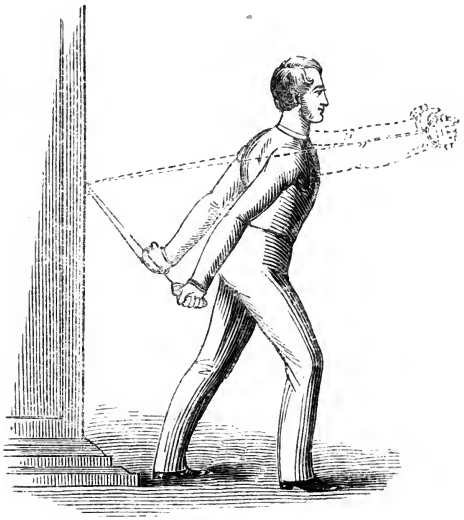


Figure 24.
Direct Forward Traction, with Permanent Extension.

position, whilst the other is brought forward; when this has been repeated the required number of times, then both arms are to be used at once.

Muscles.—The chief muscles actively exerted in this exercise are those of the chest, arms and shoulder-blades, whilst those of the lower part of the trunk are passively taxed in opposing the weights, thus assisting the arms in coming to the front of the body.

16. Erect Flexion, continued to Downward Extension.

(See *Figure* 12.)

Position.—The pupil is to be placed under the projecting arm of the Polymachinon, as directed in the first exercise of movement of arms (page 31).

Exercise.—This is precisely the same as the first exercise (erect flexion) of *movement of the arms*, in the commencement; then, instead of the arms stopping on the chest, and again ascending, they are to be gradually extended downward by the side of the body, and from this position allowed gently to ascend; first one arm is to be used, then alternately, and finally both together, for the required number of times.

Muscles.—The chief muscles called into play are the *biceps, pectoral,* and some of the *dorsal* muscles; and also the *extensors* of the arms, in the downward portion of the exercise, receive great power through the movement imposed upon them.

17. Inclined Forward Traction. (*Figure* 25.)

Position.—The pupil, placed facing the front of the Polymachinon, will take hold of the two top handles with the hands, and draw them out towards the body, and remain in position with both arms extended. The feet

are to be separated, one placed before the other, and firmly planted on the floor.

Exercise.—One arm is now to be gently flexed, and the hand drawn up close to the chest; as this arm gradually extends the other is to be bent, and so the exercise is to continue, the arms moving alternately. The feet are then to be reversed and a similar series of movements performed, when both arms are to be used together (see *Figure* 24). The exercise terminates when the required number of movements have been performed.

Muscles.—The muscles mostly called into play in this exercise are the *biceps* and *pectoralis, major et minor,* &c.

The *Figure* to this Exercise will be found at the end of the Work.

MOVEMENTS OF TRUNK AND ARMS.

1. Upward Brachial Traction, with Movement of Trunk. (*Figure* 26.)

Position.—The pupil is to be placed erect, opposite the apparatus, the heels together and toes apart; the knees are to be kept flexible, not by any means stiff or rigid; inclining the body forward, with the head downward, the handle, which is situated at the base of the machine for that purpose, is to be taken hold of by both hands, one at each extremity, not grasping it, but letting it rest on the first phalanx of the fingers, the thumb quite apart, with the arms extended.

Exercise.—The first movement is to proceed from the back, it being gradually extended on the loins, the arms at the same time bending upwards, until they are perfectly stretched over the head, with the trunk quite erect; the handle, it must be observed, has now changed its position in the hand,

and instead of being on the fingers, on its progress upwards, has shifted and rests between the thumb and first finger; from here it must descend, by bending the arms and allowing the trunk to come forward, until arrived at the position of starting; the exercise is completed when the number of times upwards and downwards have been performed. This exercise may be performed without bending the arms, keeping them always quite extended.

Muscles.—The back in this exercise is chiefly acted on, and consequently its chief muscles; the arms, chest and legs also undergo a fair amount of exertion. The principal muscles of the back are the *trapezius, sacro-lumbalis, longissimus dorsi, &c.*, and, in fact, all the muscles undergo a general action; the *deltoid* acts in raising, while the *biceps* acts in bending the arm; the muscles also of the chest are duly exerted, as well as those *(extensors)* of the leg.

2. Prone and Supine Movement of Trunk, with Brachial Flexion and Extension. (*Figure* 27.)

Position.—The pupil is to be seated on the graduated stool, with the feet resting against the board placed for that purpose, the heels together and toes apart, the body erect, with the handle in hand, each being placed at the extremity of the staff, the knees slightly bent, and elbows close to the side.

Exercise.—This exercise is somewhat similar to that of rowing in a boat. The body is to be dropped forward over the knees, at the same time extending the arms fully, and reaching as far over the toes as possible; then, by pressing with the feet against the board, the body is to be brought well back, until the shoulder blades rest on the pad of the stool placed behind for that purpose, the arms bent, and the elbows close to the side, the hands being brought to about the height of the chest; repeat the movement forwards and

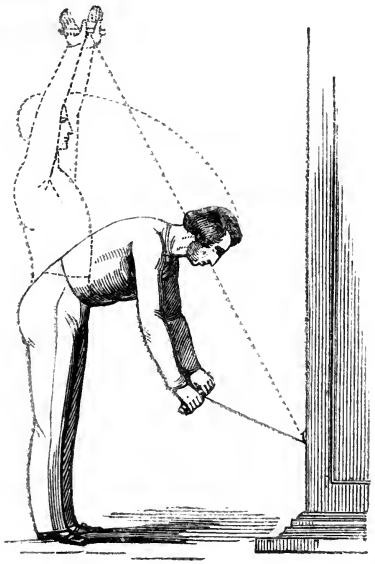
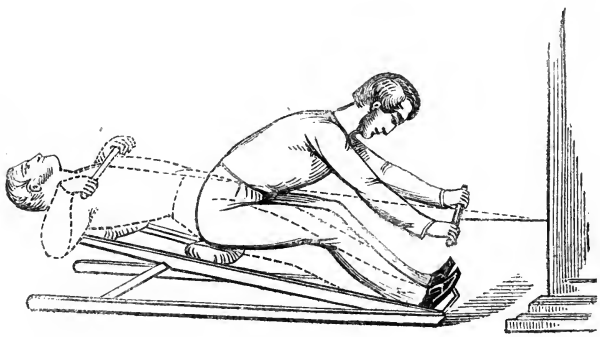


Figure 26.

Upward Brachial Traction, with Movement of Trunk.



Prone and Supine Movement of Trunk, with Brachial Flexion and Extension. (*Figure* 27.)

backwards until the conclusion of the exercise. One hand may be used singly, in place of both, using first one and then the other.

Muscles.—The muscles acted on in this exercise are precisely the same as those in the preceding one, with the exception of the muscles of the chest.

3. Lateral Traction of Trunk, with Brachial Traction.

(*Figure* 28)

Position.—Place the body sideways towards the machine, in a manner so as to present one shoulder (say the right), separate the legs, leaving an interval of about two feet from foot to foot, the knees quite straight, that is flexible with no stiffness; take hold of the handle, which is at the bottom of the apparatus, in this instance with the right hand, the arm quite extended, the left arm hanging down by the side, or the hand placed on the hip; the body quite erect, and the head neither turned to one side nor the other.

Exercise.—Commence by drawing the handle up to the side, at the same time bending the body over to the opposite side as low as possible, without allowing it to fall or incline forward, (if at all out of the perpendicular it must be backwards,) until the handle touches the side, as high as possible under the arm; from this position the trunk is to follow the arm as it descends, until stretched as much over on that side, as it was on the other; continue the movement from side to side to complete the exercise, very gently and gradually, for a certain number of times; then turning the body round and presenting the left shoulder to the apparatus, perform the same movement with equal care, observing the same rules until the exercise is finished.

Muscles.—This exercise calls into action the *oblique* muscles of the abdomen *(obliquus externus et internus)*

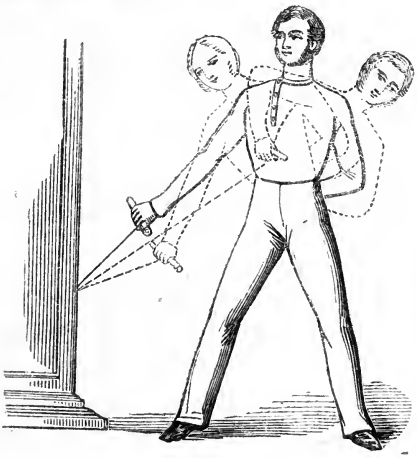


Figure 28.

Lateral Traction of Trunk, with Brachial Traction.

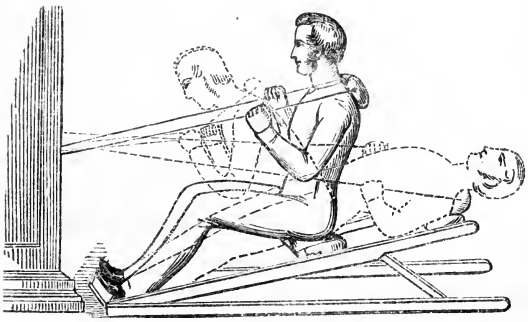


Figure 29.

Prone and Supine Movement of Trunk, with Flexion and Extension of Legs.

most efficiently; the *quadratus lumborum* is also exercised, as well as the *intercostal* muscles, the *serratus magnus* and the *pectoral* muscles. The *flexors* and *extensors* of the arms are also brought actively into play.

4. Prone and Supine Movement of Trunk, with Flexion and Extension of Legs. (*Figure* 29.)

Position.—The pupil, seated on the graduated stool, placed at a correct distance from the machine for that purpose, so as to allow of the proper flexion and extension of the legs (of course where the legs are long, as is the case with a tall person, the distance must be increased; if the person is short, the reverse is to take place), places both feet (with the heels united and toes apart) against the base of the machine; here the body must be bent over the knees, and taking hold of the padded handle with both hands, one at each end, draws it towards and passes it over the head, laying it on the shoulders, taking care when this is done to place the hands on the ropes, at about eighteen inches from the handle, so as to prevent the possibility of its slipping off.

Exercise.—The pupil, having been placed in position as directed, will commence slowly and gradually to lean back, pushing the head in the same direction, until in a horizontal position with the trunk and feet, the knees, of course, being thoroughly extended; let the body now ascend, until it is again flexed over the knees at the loins; continue the movement forwards and backwards, until the exercise is finished.

Muscles.—From the nature of this exercise, resembling so closely that of the fourth exercise, it is evident that the muscles acted upon in each are precisely the same, with the exception of those of the arms, which being on

the cords, are inactive. The *flexors* and *extensors* of the legs are alternately exerted, as also the *extensors,* or rather *erectors* of the trunk on the loins, and those of the neck and head on the trunk. Through this movement, the whole complex of *dorsal* muscles is brought into a thorough state of action, without using the upper limbs.

5. Semi-Rotation of Trunk, with Brachial Flexion and Extension. *(Figure* 30.)

Position.—The object of this exercise being that of expanding the chest, at the same time acting upon the loins, the pupil, as in most of the standing positions, is to be placed, quite erect, opposite the front of the Polymachinon; the legs are to be kept rather bent and separated about two feet; the feet firmly planted on the floor, directly opposite each other, so as to fix the body securely; the toe of the advanced foot pointing direct to the machine (about two feet from the base of it), while that of the other is directed outwards and parallel to it, so as to throw the knee of the limb outwards, as also the hip and shoulder; it may be as well to observe here, that whichever hand is highest in situation or position in the exercise, the foot on the same side must be correspondingly advanced; thus, if the right hand from this position takes hold of one of the two highest handles in front of the machine on that side, the arm being kept extended, the corresponding foot must be placed forward, and *vice versa.*

Exercise.—Following the rules laid down for the position, the extended arm is to be drawn close to the side very slowly and gradually, at the same time as the other is duly extended, the shoulder being brought forward, or thrown back, by a rotary movement of the hips *(pelvis),* in accordance with the arm as it is extended, or contracted. This

cross movement being repeated the required number of times, the position of the body, legs, feet and hands, is to be reversed, in order to equalize the exercise and consequent development of the whole system of muscles brought into play. The same rules are to be observed when the body is changed.

Muscles.—Studying the various movements that the limbs and trunk undergo in this exercise, it will be observed, that the *flexors* and *extensors* of the lower and upper limbs are alternately brought into action; while the *rotators* of the trunk on the loins, and those of the head on the trunk, are also exerted. Some of the *dorsal* muscles, (especially such as are attached to the shoulder blade,) as also those of the abdomen and chest are considerably acted upon. From the multiplicity of muscles thus exerted, this exercise is calculated to impart strength to the whole system.

6. Rotation of Trunk, with Lateral Brachial Extension.

(*Figure* 31.)

Position.—The position of the body is as in the lateral extension of the arms (*vide p.* 32).

Exercise.—This is in many respects like the fourth exercise in movements of arms, only that the trunk, instead of being stationary, is moved round on the loins, as the arm is either flexed or extended; thus adding greatly to the power of the movement, and requiring increased weight in the machine.

Muscles.—As already observed, the point in which this exercise differs from the above-mentioned exercise is in the rotation of the trunk on the loins; thus, besides bringing into action the same muscles of the arms as in that exercise, the *oblique* muscles of the abdomen and *rotators* of the spine are strongly acted upon, creating great power in those organs.

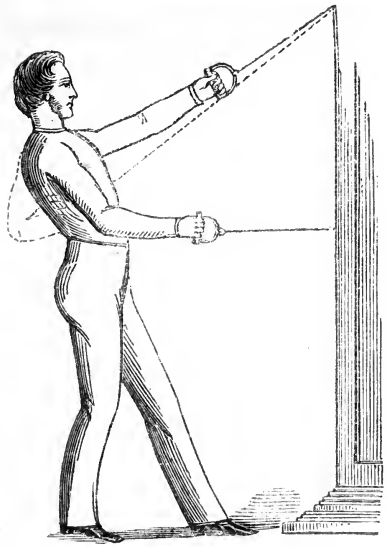


Figure 30.
Semi-Rotation of Trunk, with Brachial Flexion and Extension.

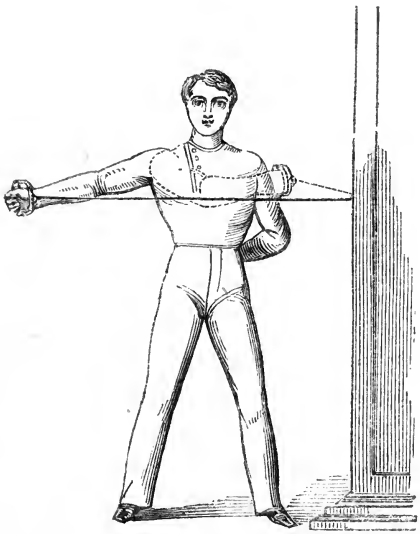


Figure 31. Rotation of Trunk, with Lateral Brachial Extension.

7. Rotation of Trunk, with Lateral Brachial Flexion. (*Figure* 16.)

Position.—The body is placed as in the lateral flexion and extension of the arms (*vide p.* 33).

Exercise.—The handle, being held as in the above exercise, is drawn from one side of the body to the other; but, instead of the body being kept perfectly still, it is to turn on the loins as the arm is moved from one side to the other; hence the difference between the two exercises; this movement gives much greater power to the whole body to perform the required exercise.

Muscles.—The object of this exercise being that of increasing the power and strength of the loins, it is evident that, through the rotary movement given to the whole trunk on that part, the desired end will be attained by exerting and thus developing those sets of spinal and abdominal muscles which are requisite to the movement. The same muscles of the arm, chest, shoulders and shoulder blades, as in the exercise before alluded to, are also acted upon.

8 & 9. Rotation of Trunk with Brachial Abduction and Adduction, with Permanent Extension. (*Figures* 16 *&* 31.)

Position.—The position of the pupil in these two exercises is precisely like the two last.

Exercise.—These exercises differ from the two last, simply owing to the arm being kept extended throughout the exercise, instead of being flexed and extended alternately.

Muscles.—In addition to those muscles which are acted upon in the two last described exercises, we have all those sets of muscles situated at the lower part of the trunk,

whose office is either separately or jointly to move it on the loins in a rotary direction *(rotators)*, called actively into play, and also the *extensors* of the arm.

10. Downward Rotatory Brachial Traction, with Forward Movement of Trunk. *(Figure* 32.)

Position.—The pupil, standing erect, with the front of the body towards the machine, heels together with toes apart, having the knees quite straight (at a distance of about three feet from the base of the Polymachinon), will take hold of the handle (placed at about one foot from the top of the apparatus for that purpose) with both hands, one at each extremity, retaining the hold simply with the fingers, taking care never to grasp it.

Exercise.—The handle, in the commencement, is brought down, not by flexing the arms, but by inclining the body forward on them, and by a slight flexion of the lower limbs, until it has arrived at a low point in front of the body; from this position it is now allowed to ascend, being drawn upwards and towards the chest by bending the arms, thus performing a rotatory movement at the shoulder, and continuing and finishing by extending the upper limbs, gradually resisting the weight as it descends until the first position is again attained. The exercise will be completed when the number of times have been performed.

Muscles.—The chief muscles that are acted upon in this exercise are those whose office it is to move the trunk forward, as the *rectus abdominis, pyramidalis, psoas magnus et parvus,* whilst the muscles of the chest are beneficially exerted in drawing the arms downwards, as the *pectoralis major et minor,* by the development of which the chest *(thorax)* is opened and wonderfully strengthened; whilst, on the other hand, the development of the *abdominal* muscles before mentioned prevents, to a very great extent,

many of those serious accidents, so frequently produced through weakness of those parts, when the *viscera* are forced against the cavity of the abdomen, as in lifting heavy weights, &c.

11. Upward Traction of Trunk, with Flexion and Extension of Legs. (*Figure* 33.)

Position.—The pupil in this exercise is placed in front of the machine, in the erect position, with the heels together and toes apart, close to or within two inches of the base; the body is to be inclined forward, and with both hands the padded handle at the bottom is to be taken hold of at the extremities, passed over the head and deposited on the neck and shoulders; the hands are then removed and placed on the cords, so as to steady it.

Exercise.—From this position the body is to be gently inclined forward, at the same time that the legs are gradually bent, continuing this until the body is seated on the heels, and bent well forward over the knees, with the head inclined rather downwards; the reverse of this movement is then to take place, by the head in the first instance being gently forced upwards as the legs are slowly straightened, when the trunk acting in uniformity with the legs is gradually extended on the loins, until the erect position is again attained. This movement downwards and upwards must be continued until the exercise is completed.

Muscles.—In this exercise the strength likely to be acquired by the loins, back and neck, is evident from the combined action of the different sets of muscles which are brought into play throughout the movement, viz., the *trapezius, latissimus dorsi, sacro-lumbalis, longissimus dorsi,*

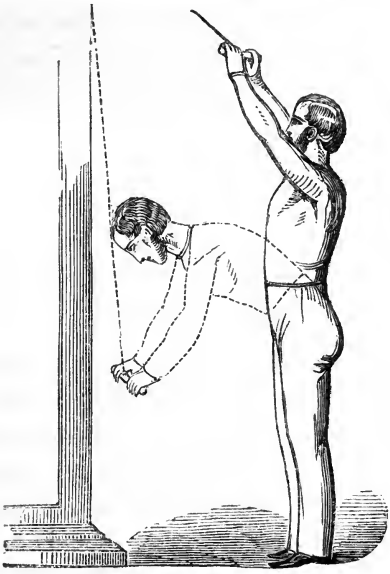


Figure 32. Downward Rotatory Brachial Traction, with Forward Movement of Trunk.

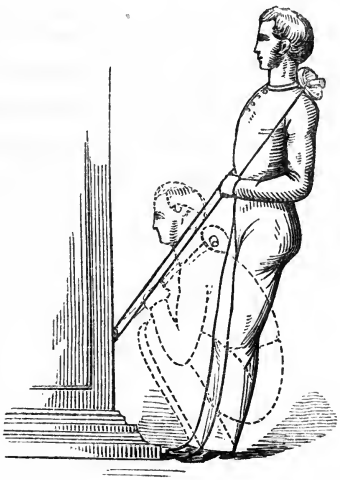


Figure 33.

Upward Traction of Trunk, with Flexion and Extension of Legs.

&c. The *extensors* of the neck on the trunk, of the trunk on loins, and thighs on legs, are all actively exerted, thus developing the various organs of those regions.

MOVEMENTS OF THE LEGS.

1. Downward Traction or Extension. *(Figure* 34.)

Position.—The apparatus for movements of the lower extremities is, in most cases, placed at the back of the Polymachinon, although instruments are made expressly for their sole exercise. The pupil, who is to stand erect, facing the machine, will pull down one of the two cords (which are in front, and to which the proper slipper is attached), then by raising the corresponding foot, will adjust the strap, merely by slipping it over the toe to the instep; this foot is then to be replaced on the ground, when the other is to be arranged in like manner; the hands are now either to take hold of the cords (not aiding at all in the movement) or to rest on the side of the machine, the head with the body to be always held well up.

Exercise.—One foot is now to ascend, by bending the knee and permitting it to rise as high as possible to the front of the body, resisting in its ascent the weight, so that no jerk may be given to the active limb; from this position the leg is again to be extended, forcing the foot downward until arrived at the first attitude, when the other limb is to perform a similar movement, continuing it alternately until the required number of times is completed. Care must be taken throughout the exercise that the cords must be always kept to the inside of the knees,

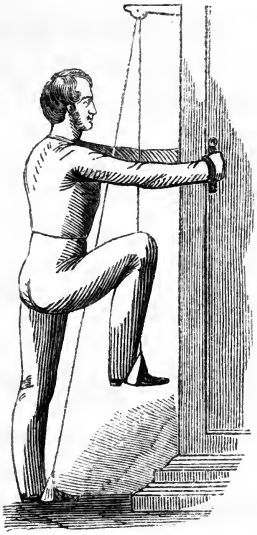


Figure 34. Downward Traction or Extension.

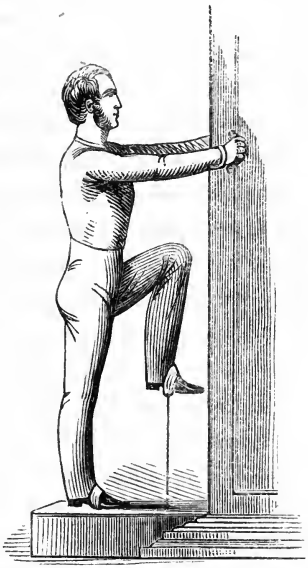


Figure 35. Upward Traction or Flexion.

never otherwise. Where either limb has any peculiar defect to be remedied, of course the mode of applying the movements must be regulated by the instructor.

Muscles.—From the flexed position the limb is brought downwards, through the combined actions of the *extensors* of the leg, or rather thigh, on the trunk; the principal of which are the *glutæus maximus*, part of *glutæus medius*, long head of *biceps, semi-tendinosus*, &c.; and the leg is extended on the thigh through the combination of the *rectus, vastus externus et internus*, and *crureus*. Through a perfect development of these various organs great strength is communicated to the whole thigh, whilst the strength acquired by the first class of muscles produces a beneficial effect, inasmuch as by them the trunk is kept in an erect position when the limbs become fixed.

2. Upward Traction or Flexion. (*Figure* 35.)

Position.—The pupil is placed, with regard to the machine, as in the last; the feet are then to be fixed in the slippers which rest on the stool at the base of the apparatus, the body assuming the erect position, with the hands resting on the sides of the Polymachinon.

Exercise.—Commence by raising one foot (say the right) as high as possible in front of the body, by flexing the leg at the knee, the front of the foot being directed upwards; the left leg is to be kept quite straight whilst the other is in motion, and *vice versa;* now allow the raised foot to descend, gently resisting the weight, until it arrives in position on the stool, with the leg perfectly extended as in the commencement, when the left foot is to perform a similar movement to the one just described; taking care that it is gradual, and that there is no jerk attending the extension or flexion of the limb. The exercise terminates when the required number of times have been completed.

Muscles.—The chief muscles are such as are brought into action when the thigh is flexed on the trunk, and the leg on the thigh, namely, the *psoas magnus, iliacus, pectinæus, adductor longus et brevis,* which are exerted in bringing the limb forward; and the *semi-tendinosus, biceps, gracilis* and *sartorius,* all originating in the *pelvis* and inserted into the leg, are much strengthened in the flexion of the leg at the knee, and have a most beneficial effect in rectifying (when used in junction with the first exercise) any weakness of those parts, producing deformity of the knee, and consequently the whole limb, such as knock-knee, &c.

3. Lateral Extension or Abduction. *(Figure* 36.)

Position.—The same rules, as described in the preceding exercise, for the position of the pupil, must be carefully observed in this.

Exercise.—In the commencement, one foot (with the leg retained perfectly straight) is to be forced sideways (of course, pulling with it the slipper and weight attached thereto), not allowing it to come forwards or backwards, or the trunk to incline in the least, either to one side or the other, until the foot has reached the highest point on that side of the body. In its downward progress the pressure of the weight is to be resisted, so that no jerk may be given to the limb; as soon as one member has completed the required number of movements, the other must be exercised in like manner, or the two legs may alternately be brought into action.

Muscles.—The chief are those which have a tendency to separate the legs, viz. the *abductors,* and are in the foregoing exercise duly brought into a perfect state of motion. The *gluteii,* with the *pyriformis,* are thus invested with

great power, and through their development contribute greatly in sustaining the trunk in the erect position in the various movements of the lower extremities.

4. Lateral Traction or Adduction. (*Figure* 37.)

Position.—The pupil, being placed at the correct side of the Polymachinon, is to fix one foot in the slipper provided for that purpose at the base of the machine (which will be more easily accomplished by drawing it out). When properly adjusted, the foot (which in this instance will be the right) is to be separated from the left, and allowed to be drawn into position by the weight, as represented in the annexed plate.

Exercise.—The first movement is to proceed from this foot being drawn towards the left, with the knee straight, until both heels are touching on the floor; from this position it is to ascend again; so the movement is to be continued until the required number of times has been completed. The position of the body is then to be reversed, and the opposite leg used in like manner.

Muscles.—The three *adductors* of the thigh on the *pelvis* are in this exercise the chief muscles which are acted upon, assisted by the *psoas magnus, iliacus, gracilis, pectinæus,* &c.; great strength is created in these organs through this movement, and by their development the limbs are enabled to grasp an object very powerfully, as in climbing a rope or pole, or keeping one's seat on a bare-backed steed, where a hold is secured merely through the grip of the legs.

5. Forward Traction. (*Figure* 38.)

Position.—The pupil being placed standing erect with the back to the machine, with both feet securely fixed in the slippers used in the second exercise, the body inclined

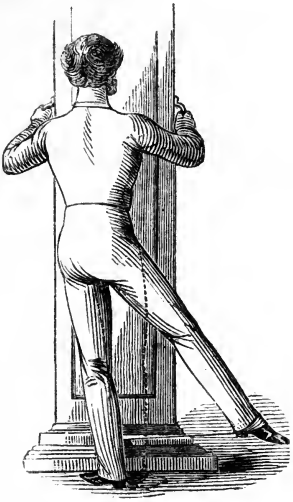


Figure 36. Lateral Extension or Abduction.

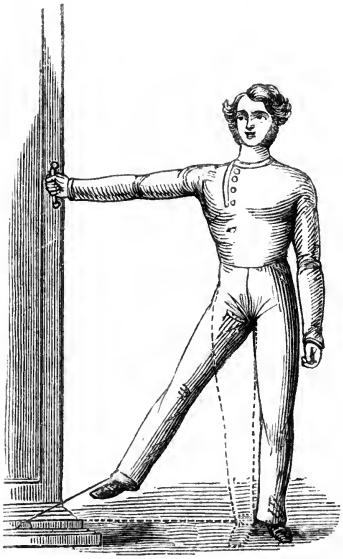


Figure 37. Lateral Traction or Adduction.

rather forward, will take a step forward with one foot, leaving the other at a proper distance behind, both being attached to the proper weights.

Exercise.—The hindmost foot is now to be brought forward, with the leg slightly flexed until perfectly extended to the front of the body, and as high as it is possible, with the toe directed upwards; from this position it is to fall again gradually backwards, and assume the first position, when the other limb is to be moved in like manner; so the movement is to be continued until the exercise is completed.

Muscles.—The combined actions of those whose office it is to move the leg forward, are in this exercise fully brought into play; and thus the *psoas magnus, iliacus, pectinæus, adductor longus et brevis,* being the chief sets of muscles used in performing this movement, are through the continued gentle exertion effectually strengthened and developed; which, besides adding symmetry to the member, aids with the preceding exercises in giving a proper command over the legs in any movement performed, either in walking, running, climbing, &c.

6. Backward Traction, with Permanent Extension.

(Figure 39.)

Position.—The pupil or patient, with heels together, is to stand erect, facing the machine, the hands resting on the sides of the apparatus, at about the height of the shoulders; the heels are now to be carefully fixed in the slippers, so as to prevent the possibility of their disengaging, lest a sudden jerk (which would thus arise) might shake the limb severely, and perhaps, if in a delicate state, do some mischief.

Exercise.—By pushing against the machine with the

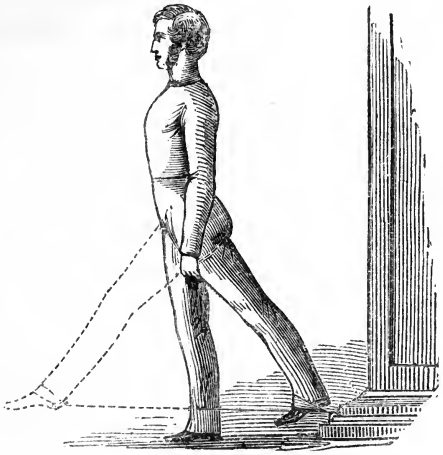


Figure 38.
Forward Traction.

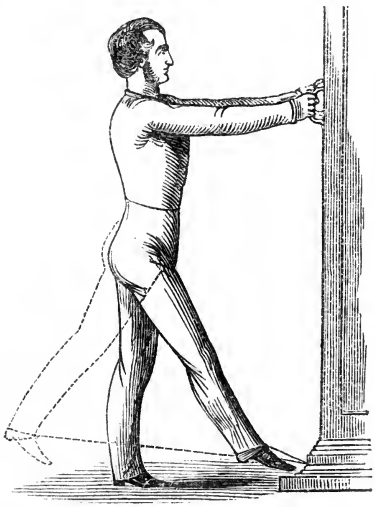


Figure 39.
Backward Traction, with Permanent Extension.

hands, one foot is to be forced back as far as possible, with the toe directed downwards, the leg throughout being retained straight; from this attitude the leg is to be allowed to come forward (resisting in its onward progress the weight, so that no jerk may arise), until again arrived at the point of commencement, when the other leg in its turn will be made to perform a similar movement backward and forward. By an alternate movement of the limbs for the required number of times, the exercise will be brought to a termination.

Muscles.—From the nature of the above-described exercise, it will be perceived that it is calculated to bring perfectly and freely into action all such muscles, or sets of muscles, as are destined to move the leg directly backward, when of course the trunk becomes fixed. Thus we observe, through a continuation of this movement, that the development of the *obturator internus*, *semi-tendinosus*, *semi-membranosus*, and part of *adductor magnus*, is satisfactorily secured; whilst all those which have a direct tendency in moving the limb outwards, as in the third exercise *(Lateral Extension or Abduction)*, are, in combination with the foregoing, acted upon and strengthened.

7. Forward Rotation. *(Figure* 38.*)*

Position.—The rules, as laid down in the fifth exercise, for the position of the pupil, must in this be carefully observed.

Exercise.—One foot is now to be brought to the front of the body, with the knee perfectly extended as high as possible. From this point it is to be passed backwards, describing in its transit a semicircle, by forcing the foot gradually to the outside, and performing a rotary movement at the hip-joint, until the foot has reached the farthest

point behind the body, when it is to be brought into position with its fellow on the floor; the other foot is now to perform a similar movement, and so on alternately, until the required amount of exercise has taken place.

Muscles.—Those muscles whose office it is to move the limb forward, as in the fifth exercise, are, in combination with such as are duly exerted in the third exercise, brought thoroughly and perfectly into action. The chief will be the *psoas, iliacus,* &c., in unison with the *gluteii, pyriformis,* &c. This exercise is calculated to give a perfect degree of freedom in the hip-joint, where stiffness, produced from some cause or another, exists, and assists materially in effecting an elegant and easy carriage.

8. Backward Rotation. (*Figure* 39.)

Position.—The pupil in this exercise must be placed as in the sixth exercise, observing, particularly, all the rules laid down therein.

Exercise.—One foot, say the right, must now be forced gently and gradually backwards, until as far and raised as high as possible behind; from there it is to be brought forward by a circular movement at the hip-joint (similar to that described in the preceding exercise, only instead of a backward movement it will be the reverse), until the foot has reached its point of destination in front of the body, when it is to be brought in position close to the left, which, on its becoming fixed, will perform a similar movement, until the number of times required for the completion of the exercise has been executed. It must be recollected, and attention paid thereto, that the knees are to be kept perfectly straight throughout the whole of the exercise, and that not the least jerk must be allowed to be felt by the limb.

Muscles.—Those muscles which are brought into play in this exercise, are such as move the limb backwards, as in the sixth exercise, in combination with those whose office it is to move the leg sideways, as in the third exercise; thus giving, through their development, increased power in unison with the muscles acted upon in the last-described exercise, in acquiring and perfecting the results therein indicated.

9. Reclined Downward Traction, with Permanent Extension.

(*Figure* 40.)

Position.—The pupil being in a recumbent posture on the back, on the graduated couch, will have the feet fixed and well secured in the proper straps.

Exercise.—One leg, which is in the air, supported by the cord, is now to be brought down at full length and placed by the side of its fellow, when the other leg is to ascend, never allowing it to bend in the least; when the required number of movements have been executed by each leg, then both limbs may be used together. Another form of this exercise is to flex the limb as it ascends and extend it as it descends. (See *Fig.* 41.)

It may be well to add, that all the movements of the upper and lower extremities may be performed in the recumbent posture, and even when required, both arms and legs are exercised at one and the same time. The pupil is generally to lie down during these exercises, when any weakness of the spinal column is apparent.

Muscles.—The muscles in the region of the hip-joint are in this exercise chiefly brought into play; thus, any weakness of that part will speedily disappear.

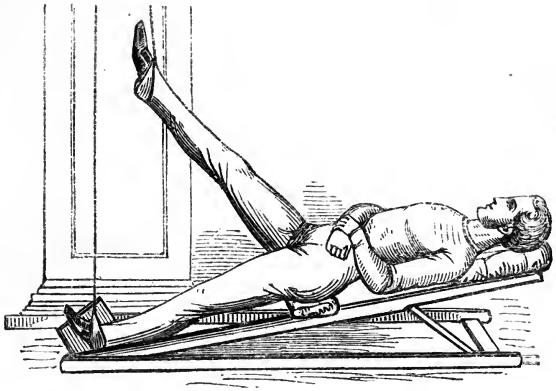


Figure 40.

Reclined Downward Traction, with Permanent Extension.

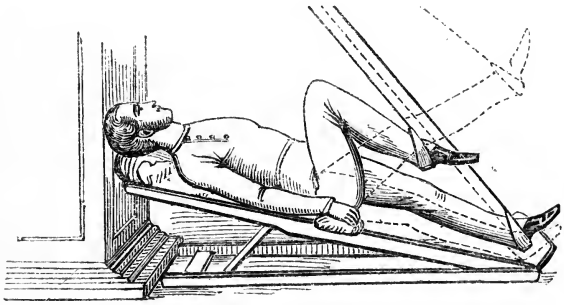


Figure 41.

10. Flexion of Limb at Knee only. (*Figure* 42.)

Position.—The pupil or patient, being seated, will place both feet into the suspended slippers, adjusting one at a time; the hands to be placed on the hips, or on the side of the stool, or in front of the body; the legs will rest up to the joint on the edge of the stool or chair.

Exercise.—At the commencement both legs are quite extended, the first movement then is that of bringing one foot (say the right) downwards (by bending the knee) until it touches the ground, which motion is to be performed quite slowly and without any jerk; from this position the foot is again to ascend whilst the left descends, and so the exercise is to be continued until the required number of times have been accomplished. Both legs are afterwards to be used at the same time until the required amount of exercise has been taken.

Muscles.—The chief muscles acted upon in this exercise are such as spring from the *femur* (thigh), that being the fixed point, and are inserted in the bones of the leg, *tibia* and *fibula*, and have a direct tendency in bending the limb at the knee, as the *semi-tendinosus, biceps, gracilis, sartorius*, &c.

In weakness of this delicate joint, so common amongst growing persons, this movement has been proved to be invaluable in perfectly and permanently removing defects, even where they have been of some years' standing, unless some actual disease exists.

11. Extension of Limb at Knee only. (*Figure* 43.)

Position.—The pupil or patient, seated as in the foregoing exercise, will have the feet secured in the slippers placed

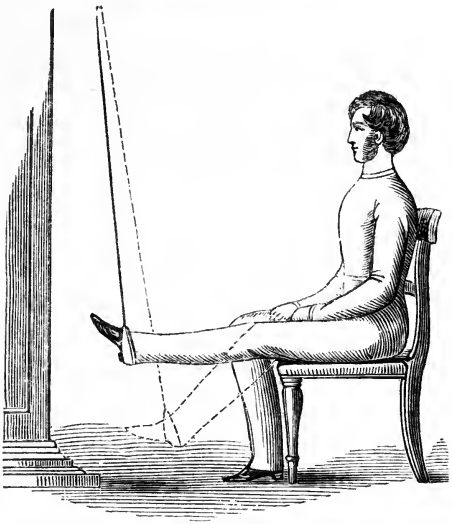


Figure 42.
Flexion of Limb at Knee only.

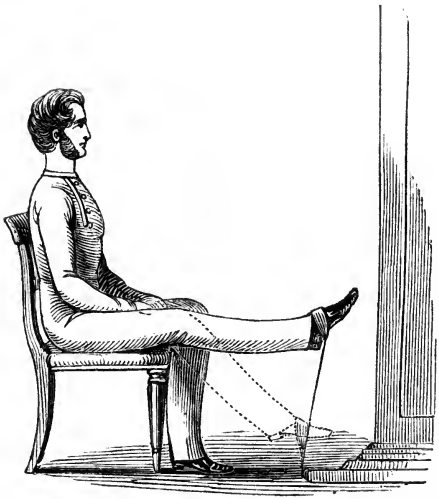


Figure 43.
Extension of Limb at Knee only.

at the bottom of the apparatus, the hands resting on the sides of the stool and the body erect.

Exercise.—One leg now, say the right, is to be extended gradually on the thigh, pulling with it the cord which is attached to the weight, until the foot is raised as high as possible in front of the body, with the toe turned upwards; from this position the foot is again to descend by flexing the leg, until it is in contact with its fellow, as at the commencement of the exercise; as the right foot resumes its former station, the left (which until now has been stationary) is to be forced gradually upwards, by a similar movement to the one described for the right, and so each foot will move alternately until the number of times required have been completed. Both feet are now to be moved at the same time.

Muscles.—This exercise it will be observed is precisely the opposite to the preceding, this being an extension, while the other was a flexion of the limb, consequently all those muscles which exert an antagonistic influence towards such as are duly exerted in the bending of the joint, will be thoroughly and perfectly brought simultaneously into action during the movement, the chief of which are the *rectus, crureus, vastus externus,* and *vastus internus.*

These, through their development, aid the *flexors* of the knee in acquiring and preserving the symmetry of the *joint, and thus of the whole limb,* giving it great power in sustaining the body firm and erect, when even great weights are placed thereon; and preventing, to a very great extent, the possibility of this complicated joint receiving any severe concussion when jumping, or during any other severe movement of the leg.

Casting a retrospective glance at the preceding pages, it is quite evident, through the varied exercises which may

be taken at the Polymachinon, that the whole muscular system must acquire that strength and development —through means the most gradual and systematic— necessary to a perfect state of health of all organs of the body, at the same time that symmetry is produced and strength attained.

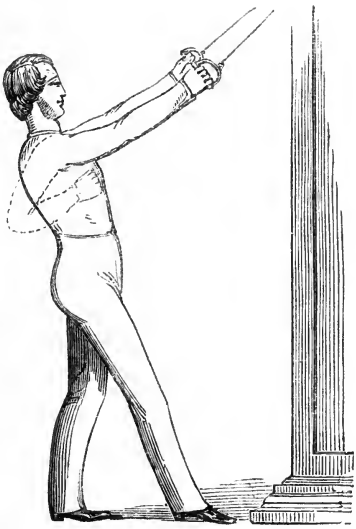


Figure 25.
Inclined Traction.

(The Exercise for this Figure will be found at page 48.)

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